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ABSTRACT

Presented are data on State and local government research and development (R&D) expenditures for fiscal year 1977. State agency R&D and R&D plant expenditures are compared graphically for the years 1964, 1968, 1973, and 1977 in both 1977 and constant 1972 dollars, and the trend of State support to R&D is analyzed. A graph of total State agency R&D expenditures by function (health, natural resources, energy, transportation, environment, education, income security and social services, food and other agricultural products, and others) and a table outlining the expenditures of each state is presented. Other tables compare the distribution of State agency R&D expenditures by source of funds, performer, and character of work and describe the distribution of personnel engaged in State R&D activities by type. A review of local government R&D expenditures parallel to the state review is provided. (GS)

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REVIEWS of data on Science Resources

NATIONAL SCIENCE FOUNDATION, WASHINGTON, D.C. 20550 NSF 80-302 NO. 35 MARCH 1980

State and Local Government R&D Expenditures, FY 1977

This report presents data on State and local government agency R&D and R&D plant expenditures for fiscal year 1977. The findings reported are based on two surveys undertaken by the National Science Foundation (NSF), covering that year. The State government survey was the fourth in a series conducted by NSF, the earlier ones covering fiscal years 1964, 1965, 1967, 1968, 1972, and 1973. The local government survey was the third in another NSF series, the earlier ones covering fiscal years 1966, 1967, 1968, and 1969. These data cover all R&D and R&D plant expenditures made by State and/or local governments regardless of source of funds or performing organizations.

Highlights

- State and local government R&D (including R&D plant) expenditures totaled $466 million in fiscal year 1977, accounting for slightly more than 1 percent of total national R&D expenditures. By comparison, Federal Government R&D expenditures accounted for 50 percent of the national total in the same year.
- Between 1973 (the last previous year surveyed) and 1977 State government expenditures for research and development and R&D plant remained almost level in constant-dollar terms. By contrast, between 1968 and 1973 such expenditures had increased by more than 6 percent per year. The recent lack of real growth in State government expenditures reflected a decline in Federal grants to the States for R&D purposes, especially for education R&D programs.
- R&D expenditures represented less than one-half of 1 percent of total State expenditures in 1977 and less than one-tenth of 1 percent of total local government expenditures. By comparison, the share of the total Federal budget devoted to R&D programs was 6 percent in 1977.
- State and local governments provided approximately one-half of the funds expended on their R&D programs in 1977 with Federal agencies accounting for most of the remainder. In both instances the Federal share had dropped from previous survey years when it had been greater than the share provided by State and local governments from their own funds.
- In 1977 approximately two-thirds of the R&D efforts supported by both State and local governments was performed directly by State and local personnel. The rest was performed extramurally—at the State level primarily by universities and colleges and at the local level primarily by private firms and nonprofit organizations.
- For both State and local governments most R&D activity involved applied research. Differences existed, however, in terms of support by function: for State governments the major R&D emphasis was on health and natural resources while for local governments the major emphasis was on energy and environment.

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Prepared in the Government Studies Group, Division of Science Resources Studies

State Government R&D Expenditures

Trends and Outlook

State support to R&D activities grew significantly between the midsixties and the early seventies, moving from an R&D and R&D plant expenditure total of $77 million in 1964 to $273 million in 1973. This represented an average real increase of 17 percent per year between 1964 and 1968 and 6 percent per year between 1968 and 1973. During the 1964-73 period, the States began to develop policies for the use of science and for the incorporation of R&D activities into program operations and into State planning at the highest levels. Since 1973, however, growth has been considerably less rapid than in earlier years, and the total of $370 million in 1977 reflected no growth in real terms (chart 1).[1] These data suggest that the States may have reached a leveling off stage in R&D investment.

A lower priority has been placed on R&D programs as State government operating costs have risen, producing pressures toward fiscal restraint. While State R&D expenditures dropped slightly between 1973 and 1977 in constant dollars, total State expenditures (direct and intergovernmental) rose by 18 percent.[2]

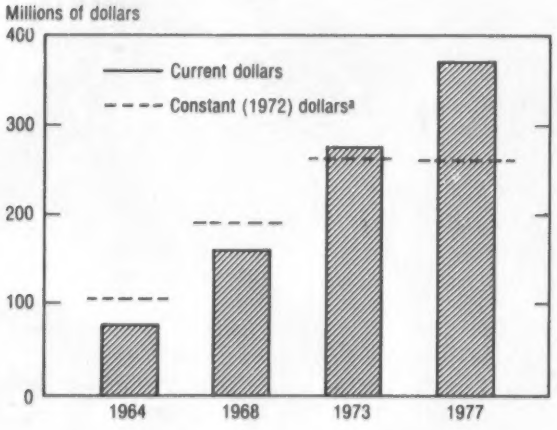
R&D expenditures of State governments comprise a fraction of 1 percent of total State expenditures. This ratio is comparable to that of Federal Government R&D outlays in the early forties when the composition of R&D activities of Federal agencies were comparable to State governments today. Previous to World War II the chief R&D efforts of Federal agencies were found in agriculture, geological surveying, weather research, and, to some extent, weapons research. Growth in R&D support was gradual until the fifties when military and foreign policy pressures resulted in a rapid escalation of R&D outlays in defense, atomic energy, and space. In the late fifties and in the sixties, health R&D programs also grew rapidly, as did work on civilian atomic energy and, later, environment-related programs and energy programs other than nuclear. The share of R&D programs in the Federal budget moved as high as 13 percent in 1965 but has fallen since then and since 1975, appears to have stabilized at about 6 percent.

In the case of State budgets, however, a sizable increase in the share devoted to R&D expenditures is unlikely even though some of the pressures relating to increased use of science on the part of the Federal Government have had repercussions at the State level. The nature of State responsibilities is such that large-scale R&D programs in defense and space will not be required. Nonetheless, other areas which are of concern to the States, have shown a record of increasing reliance on science resources. Between 1964 and 1977, the growth in energy and environment R&D efforts under State sponsorship was dramatic—from minor amounts to many millions. To varying degrees these efforts were encouraged or necessitated by Federal actions. In transportation and education the existence of Federal grants for program implementation had a decided effect on R&D growth at the State level. State income security and social services R&D programs have also been largely tied to Federal support.

[1] Not included in the 1977 survey was $2.6 billion in R&D expenditures on the part of State universities and colleges in 1977 (except for an overlap of $34 million that represented State agency R&D work performed by State universities). When State agency and State university figures are aggregated, R&D expenditures at the State level are found to represent approximately 7 percent of national R&D expenditures. R&D expenditures of State universities and colleges were included in another recurring NSF survey covering all universities and colleges in the United States: Survey of Scientific and Engineering Expenditures at Universities and Colleges, FY 1977.

[2] Department of Commerce, Bureau of the Census, *Government Finances for 1972-73 and 1976-77* (Washington, D.C.), p. 5. Intergovernmental expenditures largely represent payments made by the Federal Government to State governments in the form of grants-in-aid.

Chart 1. State agency R&D and R&D plant expenditures: selected years



[a] Based on GNP implicit price deflator.

SOURCE: National Science Foundation

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Areas of State responsibility less closely tied to Federal initiatives are health and natural resources (including food), for which, in both cases, total State R&D expenditures quadrupled in the 1964-77 period (although the increase for health largely reflected New York support). In general, State agency R&D programs have been established to meet specific State needs, often encouraged by related Federal programs or regulations that related to those needs. For the most part, State research programs have been applied in nature, and costs have generally not been high. As noted, no real growth has occurred in recent years.

Despite the lack of real growth in their R&D programs the interest of the States in the use of scientific and technical knowledge to address domestic problems is not decreasing but seems to be moving toward reliance on technology transfer as a means of supplementing State agency-sponsored R&D activities. For example, the Federal Laboratory Consortium for Technology Transfer has grown from 11 facilities all within the Department of Defense (DOD), to more than 185 laboratories and centers representing 10 Federal agencies. The Consortium was established in 1971 to stimulate the exchange of information between consortium members and to provide scientific and technical information to users in Federal, State, and local governments. Consensus among knowledgeable persons at Federal, State, and local levels indicated that the Consortium has been useful in strengthening technology transfer.[3]

Another development of considerable significance to technology transfer to State and local governments was the establishment of the Intergovernmental Science, Engineering, and Technology Advisory Panel (ISETAP) under the National Science and Technology Policy, Organization, and Priorities Act of 1976. This panel, chaired by the President's science advisor, is composed of governors, State legislators, regional and local officials, and the director of the NSF. The panel identifies and defines civilian problems at State, regional, and local levels where science and technology inputs can contribute to solutions. It establishes priorities for addressing these problems and identifies and encourages ways to facilitate the transfer and utilization of the results of Federal R&D activities to maximize their application to civilian needs. The panel has actively moved to exercise its responsibilities with staff support from the Office of Science and Technology Policy (under the President's science advisor) and several Federal agencies.

The State Science, Engineering, and Technology Program of the Intergovernmental Program of NSF is an activity designed to increase future State R&D expenditures. During fiscal years 1977 and 1978, awards were made to 49 governors' offices and 42 State legislatures to help them study ways in which they might strengthen their use of scientific and technical expertise, information, and research resources in the formulation and implementation of public policy.

Beginning in fiscal year 1980, NSF funds are expected to be made available to selected States to assist in implementing the strategies developed during the study phase. Although these funds will not have a significant direct impact on the overall level of current R&D expenditures by the States, they should stimulate an awareness of the need for research that may result in increased State R&D expenditures in future years.

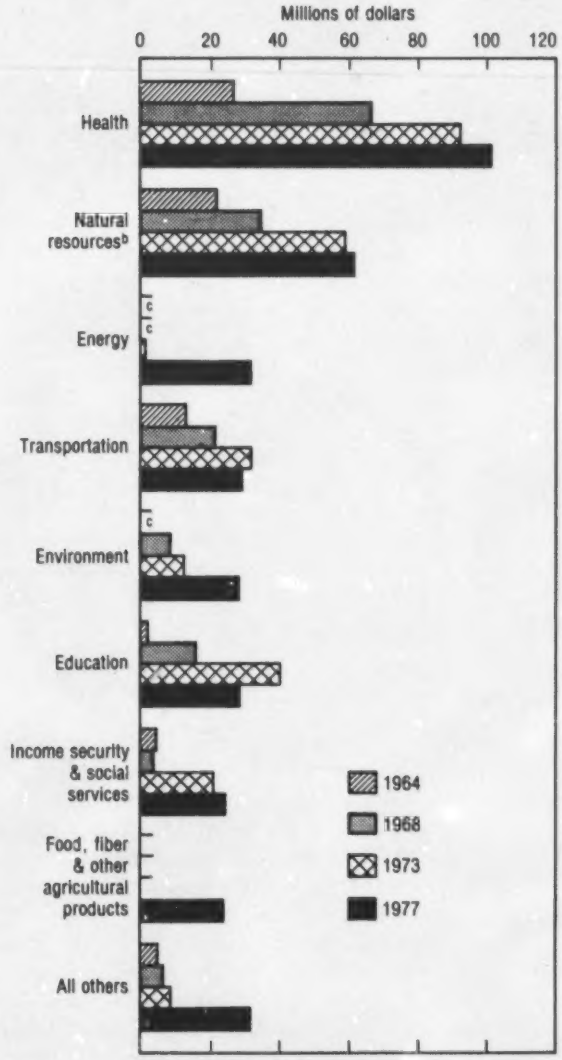
Support by Function

In 1977, as in previous years, the largest State R&D expenditures were in the areas of health and natural resources (chart 2 and table 1). But even though health R&D programs represented the largest share of overall State R&D funding, 28 percent, compared with approximately 35 percent in 1973 and 1964, health was not the major area of support for most States. The large share for health was based primarily on the predominance of R&D spending by the State of New York. In 1977 New York accounted for three-fourths of total State funding for health nationwide. More than one-half of the New York expenditures supported activities of the Roswell Park Memorial Institute, a State agency devoted to cancer research.

In current dollars there was a small increase in overall health R&D expenditures in 1977 over 1973, but in constant dollars there was a 24-percent decrease. Health failed to keep pace with both inflation and the growth shown in other fields. Although support by New York for health R&D programs rose 50 percent between 1973 and 1977, this increase was more than offset in real

[3] Robert C. Crawford, "The Federal Laboratory Consortium for Technology Transfer," *Defense Systems Management Review*, Winter 1979, Vol. 2, pp. 57 and 60.

Chart 2. State agency R&D expenditures[a] by function: selected years



[a]R&D plant excluded.
[b]Natural resources included food, fiber and other agricultural products before 1977.
[c]Less than $500,000.
SOURCE: National Science Foundation

terms by substantial decreases in support on the part of a number of other States, particularly California. Most of the decline for these States can be traced to decreases in Federal support for mental health programs by the Alcohol, Drug Abuse, and Mental Health Administration (ADAMHA) of the Department of Health, Education, and Welfare (HEW).

Natural resources, the second largest R&D support area in 1977 (17 percent of the State total) was the leading area of R&D expenditures for 19 States. At least 50 percent of the funds relate to support for fish and wildlife activities, the rest to forestry, land management, and mineral resources development. Historically, responsibility for fish and wildlife resources has been vested in the States, rather than the Federal Government. This fact, combined with the popularity of hunting and fishing, is largely behind the substantial R&D efforts made by so many States in this area over the years. Further, since most of the funds from both Federal[4] and State sources are derived from excise taxes, State fish and game agencies have been able to plan on a steady source of support, free from the fear of budgetary cuts and priority shifts experienced by agencies dependent on monies specifically allocated from general funds.

By 1977, the third largest area for State agency R&D support was energy. This area has shown the fastest real growth rate of any functional area in the 1973-77 period (R&D efforts multiplied 41 times). Energy R&D expenditures accounted for 9 percent of the 1977 State R&D total, compared with very small expenditures in 1973 and virtually none in earlier years. By 1977, the States had begun to establish programs to counteract the oil shortage that had reached a stage of national crises in 1973. Of the 1977 State energy R&D total, four-fifths was reported by five States: California, New York, Kentucky, New Mexico, and Ohio. California funded most of the State energy program through a surtax on electrical energy usage. In 1975 California established the Energy Resources Conservation and Developent Commission to develop criteria for power plant certification; energy planning, forecasting, and supply and demand studies; conservation via consumer products; and investigation of alternate energy sources. Most of the State R&D activity has been related to the work of this commission. In New York, the funds also were obtained by an assessment on electric and gas bills. New York State, with its northeastern locale, lacks adequate, indigenous energy sources, and has a large demand for fuels. In 1975 the legislators realized that they

[4]Federal support to fish and wildlife programs is provided as a result of the Dingell-Johnson Act of 1950 and Pittman-Robertson Act of 1937, which provide funds to the States (including R&D funds) on a cost-sharing basis (75 percent Federal and 25 percent State).

Table 1. State agency expenditures for research and development by State and functional area: FY 1977

(Thousands of dollars)

State	Total	Health	Natural resources	Education	Transportation	Income security and social services	Environment	Crime prevention and control	Economic growth and productivity	Area and community development, housing, and public services	Science and technology base	Energy	Food, fiber, and other agricultural products
TOTAL	358 473	100 865	61 150	28 169	29 030	24 067	28 027	13 092	6 099	12 789	50	31 450	23 685
ALABAMA	1 227	190	338	269	91	-	14	177	-	-	-	-	148
ALASKA	7 655	-	1 135	957	138	-	-	-	50	682	-	-	4 693
ARIZONA	1 684	-	377	180	489	241	129	-	158	110	-	-	-
ARKANSAS	503	27	105	-	215	99	-	9	47	-	-	-	-
CALIFORNIA	37 496	3 797	3 578	4 404	4 947	1 869	4 535	1 582	450	1 196	-	7 880	3 257
COLORADO	9 620	12	2 684	199	143	5 693	-	37	50	803	-	-	-
CONNECTICUT	4 874	928	861	52	243	281	70	883	-	75	-	526	954
DELAWARE	611	40	461	-	-	-	-	14	-	96	-	-	-
FLORIDA	13 474	2 036	1 655	2 167	1 247	1 710	261	200	56	57	-	49	3 494
GEORGIA	3 199	350	549	1 572	666	-	-	62	-	-	-	-	-
HAWAII	2 873	10	713	-	2	-	32	-	-	1 001	50	401	665
IDAHO	1 690	-	975	1	34	-	5	128	-	-	-	19	528
ILLINOIS	17 908	1 685	3 623	2 549	1 001	390	5 768	577	841	72	-	750	653
INDIANA	4 089	1 700	1 033	387	664	-	-	14	12	100	-	178	-
IOWA	2 097	-	1 161	224	400	73	35	70	-	-	-	65	69
KANSAS	4 107	7	1 941	1 562	391	50	-	-	12	42	-	-	102
KENTUCKY	6 670	-	1 257	234	1 032	90	9	-	184	72	-	3 757	35
LOUISIANA	6 525	-	5 337	-	835	-	-	44	-	284	-	25	-
MAINE	1 344	34	671	-	75	-	217	23	54	139	-	-	129
MARYLAND	8 996	1 016	1 456	-	236	132	5 144	484	477	-	-	-	51
MASSACHUSETTS	3 286	862	183	499	1 013	188	115	104	10	-	-	105	208
MICHIGAN	8 353	3 247	1 530	97	1 624	416	-	208	739	-	-	352	140
MINNESOTA	4 199	60	1 588	26	705	303	150	808	10	214	-	185	150
MISSISSIPPI	1 627	965	46	21	490	48	31	-	-	-	-	26	-
MISSOURI	2 053	-	1 525	-	250	151	-	40	-	87	-	-	-
MONTANA	2 861	-	650	44	98	303	588	-	177	23	-	978	-
NEBRASKA	641	45	422	-	30	-	-	-	54	10	-	-	80
NEVADA	1 004	-	655	-	54	375	-	-	-	-	-	-	-
NEW HAMPSHIRE	1 210	-	410	-	-	752	-	-	-	-	-	-	48
NEW JERSEY	8 497	261	558	423	677	922	343	598	-	4 293	-	-	442
NEW MEXICO	4 012	-	325	-	74	-	-	-	9	-	-	3 604	-
NEW YORK	100 695	75 919	795	1 180	1 530	2 275	8 053	2 422	515	1 168	-	6 569	273
NORTH CAROLINA	11 583	1 441	3 177	3 587	154	-	289	188	2	631	-	153	1 961
NORTH DAKOTA	1 832	-	663	318	62	-	348	-	292	76	-	-	74
OHIO	7 228	332	1 341	299	870	58	566	126	53	11	-	3 529	42
OKLAHOMA	1 453	372	462	136	256	-	180	-	29	-	-	-	18
OREGON	6 070	30	2 320	1 942	49	60	501	-	99	59	-	422	588
PENNSYLVANIA	9 264	2 660	993	1 654	1 917	-	401	640	183	401	-	304	110
RHODE ISLAND	752	-	-	137	33	22	-	10	-	250	-	300	-
SOUTH CAROLINA	4 974	590	3 197	-	85	411	19	84	-	128	-	-	461
SOUTH DAKOTA	1 262	-	1 089	-	19	-	-	-	153	-	-	-	-
TENNESSEE	1 168	58	543	105	145	242	-	75	-	-	-	-	-
TEXAS	11 836	1 328	3 968	205	2 203	426	-	298	146	37	-	458	2 767
UTAH	1 918	8	63	1 461	137	31	132	1	-	-	-	85	-
VERMONT	188	-	-	-	-	131	46	-	11	-	-	-	-
VIRGINIA	5 155	146	229	1 120	2 143	116	17	585	100	71	-	-	627
WASHINGTON	12 062	140	2 892	89	1 334	5 356	-	901	188	24	-	292	847
WEST VIRGINIA	859	124	137	-	119	56	-	-	180	202	-	40	-
WISCONSIN	4 993	423	891	67	87	797	-	1 699	216	371	-	398	43
WYOMING	716	-	586	-	23	-	29	-	-	48	-	-	29

NOTE: Because of rounding, detail may not add to totals.

- Represents zero.

SOURCE: National Science Foundation

must take steps to alleviate future energy crises. They thereby established the New York State Energy Research and Development Agency, which has played a major role in stimulating R&D efforts.

In Kentucky and New Mexico energy R&D efforts in the seventies were viewed as a means of strengthening the economies of these States. In Kentucky, where coal accounts for a significant portion of economic activity, the location of coal liquification demonstration plants and the pursuit of research on reclamation, worker safety, and coal extraction represented important efforts in 1977 toward the future health of the State economy. In New Mexico, legisators viewed energy as a new industry that could create new jobs and thus help upgrade the incomes of many citizens, and they therefore encouraged R&D efforts in this area.

Ohio, a highly industrialized State, depends heavily on energy for the smooth running of its industries. Finding ways to use indigenous, high-sulfur content coal and other longer-term energy sources is therefore of prime concern to Ohio. The State, therefore, has concentrated its R&D efforts in such areas as evaluation of coal and limestone for fluidized bed combustion and in applied technology to stimulate shale gas production.

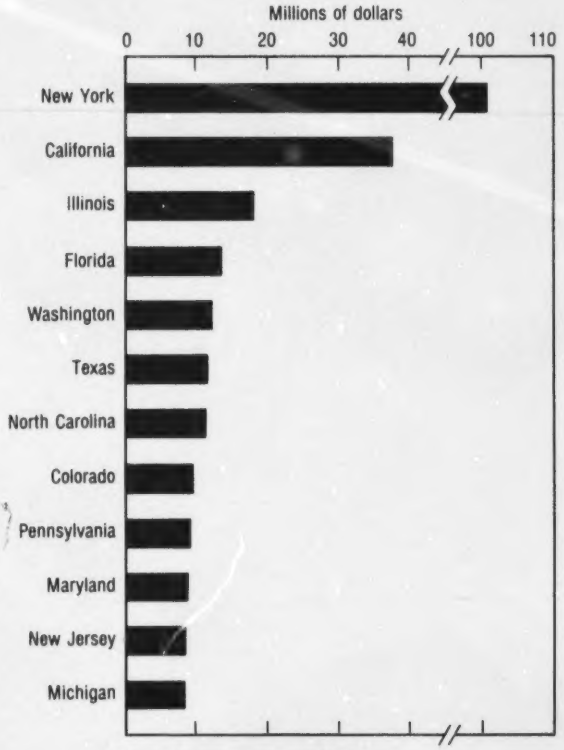
In the environmental area a continued rise was shown in State R&D spending, which, in real terms, was 68 percent higher in 1977 than in 1973. Environment represented only 1 percent of the State R&D funding total in 1964, but was 5 percent in 1973 and 8 percent in 1977. This trend reflected a host of efforts to better understand the impact of activities in transportation, agriculture, energy, natural resources, and other areas on the environment. Long- and short-term biological and cost-benefit studies have been conducted by the States. Information gained from such studies, on power plant siting, auto emissions, pest control, land use, waste disposal, flood control, erosion, etc., has been useful to officials in decisionmaking, in complying with Federal guidelines, and, in some cases, in challenging new Federal regulations and controls. Four States—New York, Illinois, Maryland, and California—accounted for more than four-fifths of the environmental total in 1977 (table 1).

State R&D expenditures for education, in real terms, dropped by almost 50 percent between 1973 and 1977. The major reason for this decline was the large drop in Federal spending, which has accounted for approximately three-fourths of all State R&D expenditures in education in the past and to which some States' own R&D dollars have been tied on a formula basis. The drop in Federal support was caused by two major factors. The first was a reorganization in HEW, when the National Institute of Education (NIE) was established in 1972 as the major research agency for education. As a result research support by the Office of Education (OE) was deemphasized, particularly in educational development. This change was especially evident in the 1977 survey; NIE did not rely as heavily as had OE on using the States for research performance. The second factor behind the drop in education support to the States was the actual decline in support by OE in the areas of vocational, occupational, and adult education; R&D activities in these areas decreased by more than 60 percent during the 1973-77 period.

Leading States

Two States, New York and California, accounted for almost 40 percent of total State R&D expenditures in 1977, with totals of $101 million and $37 million, respectively (chart 3). The other States showed a more equal distribution. Fifteen States,

Chart 3. State agency R&D expenditures by leading States: FY 1977

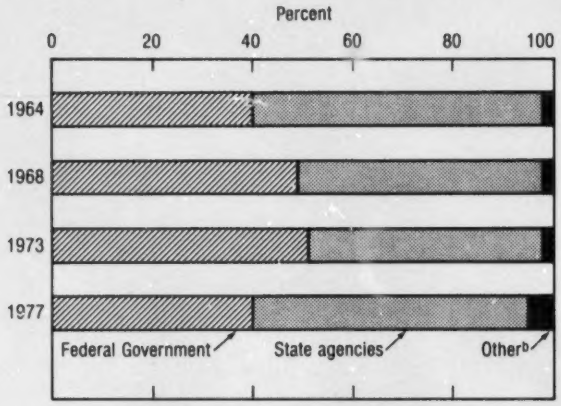


SOURCE: National Science Foundation

ranging from Illinois with $18 million in R&D expenditures to Virginia with $5 million, accounted for another 40 percent of the overall total (table 1). The chief factor in the high level of R&D support in New York was, as noted earlier, the large R&D support to health, which accounted for three-fourths of all New York State R&D funding in 1977. In the case of California, R&D support was widely distributed among a number of functions, including energy, transportation, and education. California was the leading State in R&D support in these areas. California was also among the leading States in support to virtually all of the other functions.

Other leading States tended to concentrate R&D efforts in a few areas of particular concern to their individual needs. Thus, for Illinois, environment and natural resources were the leading areas; for Florida, food, fiber, and other agricultural products; health; and education; and for Texas, natural resources; food, fiber, and

Chart 4. Distribution of State agency R&D expenditures[a] by source of funds: selected years



[a]R&D plant excluded.
[b]Foundations, business firms, and other nongovernmental sources.
SOURCE: National Science Foundation

other agricultural products; and transportation. In a few cases a specific program was responsible for most of the R&D effort of a State, as in the case of Colorado, where the major R&D effort involved an HEW-supported income maintenance experiment undertaken to test the effects of a graduated family allowance system among a representative sample of the "Poor and near poor." In this State, and in Washington, this program accounted for almost all the funds these States reported within the income security and social services functions.

Sources of Funds

In 1977 the States provided directly 55 percent of the funds they expended on R&D programs, and the Federal Government provided 40 percent. The remaining 5 percent included grants, reimbursements, and cost-sharing amounts provided by foundations, business firms, universities and colleges, and other outside sources (chart 4). The Federal share was smaller than in 1973. Federal support to the States dropped 22 percent in real terms between 1973 and 1977 while funds from State sources rose 15 percent. The major factors causing the drop in Federal R&D support to the States were a 50-percent cutback in real terms in funding for education and significant, but smaller, declines in Federal funding for health, transportation, and income security and social services. The real increase in State funds largely reflected a rise in support in the energy area, and, to a lesser extent, in natural resources (including food), health, and environment.

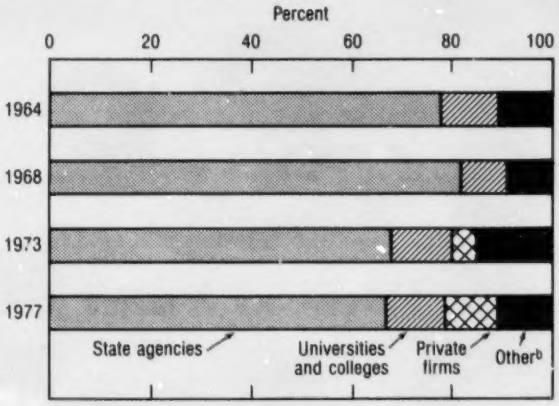
During this same period total State direct expenditures (excluding intergovernmental expenditures) increased in real terms by 21 percent.[5] When compared with the 15-percent increase in direct R&D expenditures, this figure suggests a declining priority for R&D programs in the late seventies. In 1977 R&D support to the States was provided by 78 Federal agencies. Of these, five accounted for 60 percent of the total; they were the Fish and Wildlife Service (Department of the Interior), the National Institutes of Health (HEW), the Office of Education (HEW), the Federal Highway Administration (Department of Transportation), and the Law Enforcement Assistance Administration (Department of Justice).

Performers

In 1977 approximately $241 million, or two-thirds of the R&D total, was spent on intramural R&D performance by State agencies, with the rest accounted for by universities and colleges, private firms, local governments, and nonprofit organizations (chart 5). While in most instances State governments use their own personnel for R&D performance, exceptions exist, particularly

[5]Department of Commerce, op. cit.

Chart 5. Distribution of State agency R&D expenditures[a] by performer: selected years



[a]R&D plant excluded.
[b]Includes nonprofit organizations and other government agencies, and private firms prior to 1973, but excludes private firms in 1973 and 1977.
SOURCE: National Science Foundation

in the areas of energy, education, and environment. More than three-fourths of the State-supported energy R&D effort was performed externally, by private firms or by universities and colleges. State officials explained heavy reliance on extramural R&D performance as an attempt to use existing capabilities in this rapidly expanding area and to encourage innovation and investment in energy on the part of the private sector.

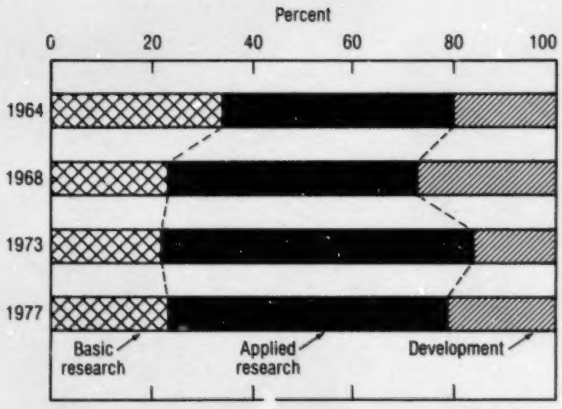
In education more than two-thirds of the R&D effort was performed extramurally, mainly by local government personnel. Approximately two-thirds of State-supported environmental R&D programs were also carried out by personnel not on State agency payrolls. Mainly, the programs were carried out by private firms and by universities and colleges where the existing resources made purchased performance more cost-effective.

Character of Work

In 1977, as was the case in previous surveys, the applied research share of the State R&D total was higher than the shares for basic research or development (chart 6). Whereas development comprises the chief area of Federal R&D activity, at the State level it is the least emphasized. State R&D efforts do not involve the heavy investments in development of complex machinery and instrumentation that characterize so much of the Federal R&D effort in defense, space, and energy. Most State R&D support is applied in character since it reflects problem-oriented research activities related to relatively short-term agency mission requirements.

The cost/revenue squeeze on State budgets does not allow for large-scale development projects or widespread funding for basic research per se. An exception exists, however, in the health area, where two-thirds of all State basic research is focused. More than one-half of the overall State R&D effort in health is basic research, reflecting the emphasis placed on long-term biomedical investigations similar to the basic research support provided by NIH at the Federal level. Another exception is in the education area, where the States reported 60 percent of all R&D efforts as development in 1977; nationwide, much of the R&D activity in education is of a developmental nature. Further, approximately one-half of State agency R&D expenditures for area and community development, housing and public services, and nearly one-half of the energy R&D expenditures were directed to development programs in 1977.

Chart 6. Distribution of State agency R&D expenditures by character of work: selected years



SOURCE: National Science Foundation

R&D Personnel

State government R&D expenditures reported in the State survey (as well as the local survey) cover both intramural performance, or R&D undertakings performed directly by State personnel, and R&D efforts performed extramurally by private firms, universities and colleges, nonprofit organizations, or other governments. Data collected on personnel, however, covered only State and local intramural performance; they did not cover those portions of State agency or local government R&D activities contracted out to other performers.

In 1977 total personnel[6] engaged in State agency intramural R&D performance showed a drop for the first time since 1969, reflecting the real drop in R&D funding noted earlier (chart 7). The 1977 survey showed that 10,500 State employees, including 5,100 scientists and engineers, were engaged directly in R&D undertakings. These numbers compare with a total of 11,500 in 1973, including 4,900 scientists and engineers. The number of scientists and engineers rose by 4 percent at the same time that total personnel dropped 9 percent. The rise could be indicative of the

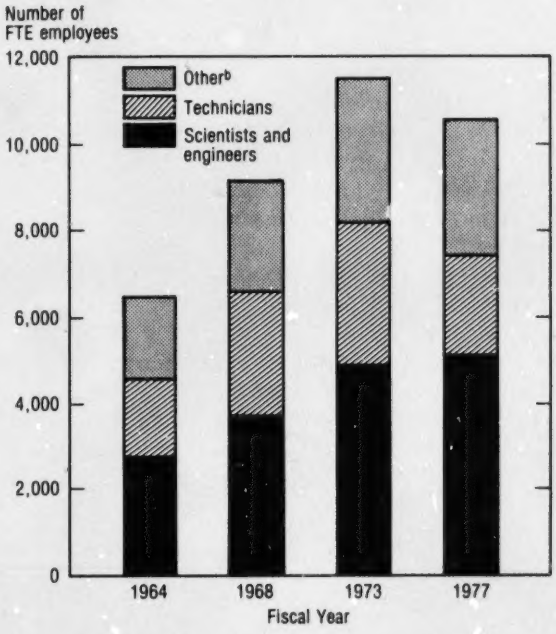
[6]Personnel numbers are derived on a full-time-equivalent (FTE) basis.

increasing number and complexity of State R&D programs and the consequent need for a higher ratio of skilled personnel to perform the work. During the 1973-77 period, FTE scientists and engineers employed in research and development in the Federal Government also increased by 4 percent. The increase in FTE scientists and engineers in industry and universities and colleges, however, was considerably higher in this period, amounting to 9 percent and 18 percent, respectively.[7]

The annual cost per R&D scientist or engineer in State government rose from $21,000 in 1964 and $36,000 in 1973 to approximately $47,000 in 1977. These amounts include not only salaries of scientists and engineers but also all supporting costs, i.e., the salaries of technicians and other support personnel, as well as supplies and other overhead items. Between 1973 and 1977 a slight decrease in per capita expenditure is seen after making an allowance for inflation.

[7] National Science Foundation, *National Patterns of R&D Resources: Funds & Manpower in the United States: 1953—1978-79* (NSF 78-313) (Washington, D.C.: U.S. Government Printing Office, 1978), p. 45.

Chart 7. Distribution of FTE[a] personnel engaged in State agency intramural R&D activities by type: selected years



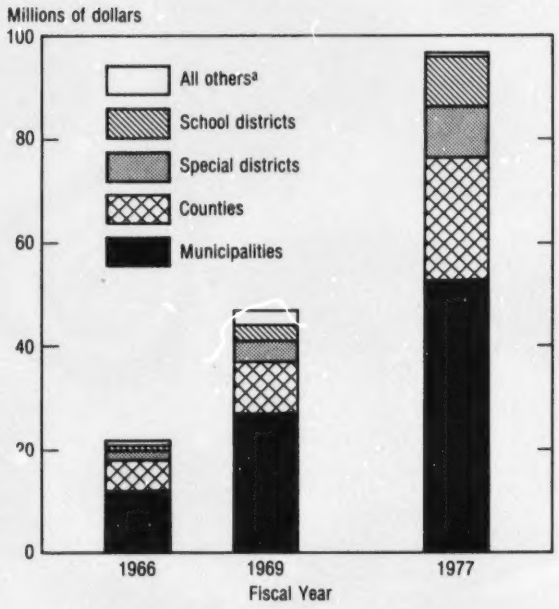
[a] Full-time-equivalent.
[b] Clerical and administrative support personnel.
SOURCE: National Science Foundation

Trends and Outlook

In fiscal year 1977 total R&D and R&D plant expenditures of local governments were $96 million, compared with $21 million in 1966, the first year surveyed (chart 8). Between 1966 and 1969 such expenditures rose substantially in real terms, for an annual average increase of 25.5 percent, but between 1969 and 1977 the real average annual increase fell to 2.8 percent. This development paralleled the R&D funding trends of the Federal Government and State governments in the same periods.

Local government R&D expenditures doubled between 1969 and 1977, as did total local government expenditures. The R&D portion of local government budgets remained very small—less than one-tenth of 1 percent of the total. As in the case of State governments, local governments in the present inflationary period necessarily spend most of their limited funds on operational activities. The use of scientific programs to help solve or alleviate local government problems has been restricted by the pressure of higher-priority needs. This situation will probably continue for some time.

Chart 8. Local government expenditures for R&D and R&D plant by type of governmental unit: selected years



[a]Hospital districts and townships.
SOURCE: National Science Foundation

Much research of direct concern to local governments continues to be performed by universities, industry, nonprofit groups, and State and Federal agencies. Areas of special concern include air and water pollution, solid waste disposal, energy development and conservation, education, crime prevention, and public management. More important than the level of local government R&D expenditures may be the benefits realized by local governments through the application of R&D results, regardless of the source of sponsorship.

In this connection, it should be noted that NSF, through its Intergovernmental Program, is supporting a variety of projects to test alternative ways by which general purpose local governments (municipalities, counties, and townships) can strengthen their capacity to utilize the results of research in their management and operations and in the formulation and implementation of policy. These projects include the Urban Consortium, which deals with all cities of more than 500,000 population, plus 8 large urban counties; the Urban Technology System, which brings together approximately 30 cities and counties in the population range of 50,000 to 500,000; the Community Technology Initiatives Program, which involves approximately 30 communities of under 50,000 population; and approximately one dozen local government innovation groups throughout the United States, which link local governments of varying sizes in the same State or multi-State region.

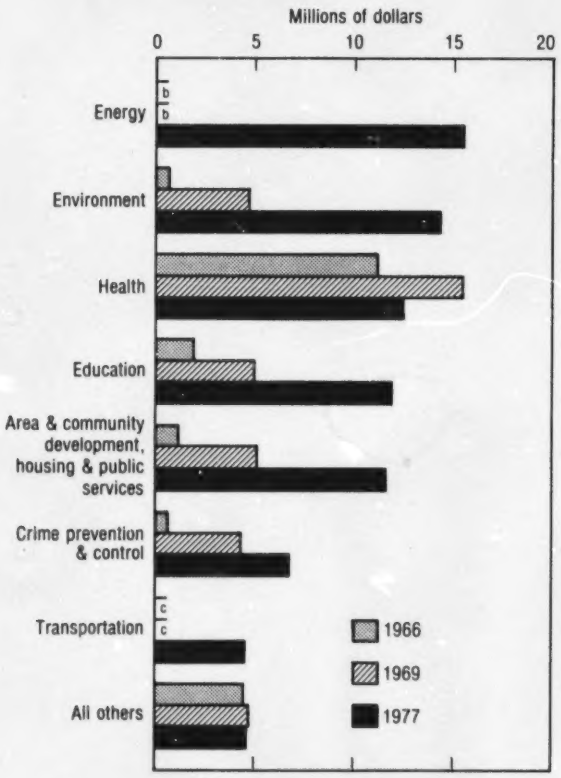
These "networking" organizations operate on the premise that a group of acknowledged leaders in local governments can cooperatively identify problems, common to all of them, which are amenable to the application of technology. Local governments, typically, are not able to undertake high-risk ventures, and the network helps to remove some of the risk. Once state-of-the-art solutions are proven practical by one governmental unit, they are given wide dissemination. As they

become adopted by others, they evolve into state-of-the-practice methods to solve local government problems. Such methods have covered police manpower deployment and refuse collection route models, lightweight body armor for police, infrared electronic distance meters for traffic control, and disaster warning systems.

Support by Function

Overall, local government R&D expenditures are heavily concentrated in a small number of functional areas: energy; environment; health; education; and area and community development, housing and public services. In 1977 these five areas accounted for four-fifths of the local government R&D total (chart 9).

Chart 9. Local government expenditures[a] by function: selected years



[a]R&D plant excluded.
[b]In 1966 and 1969 research in the area of energy was not statistically significant, and was subsumed under the "other" category.
[c]Less than $500,000.
SOURCE: National Science Foundation

R&D activities in energy rose from less than 1 percent of the R&D total in 1969 to 19 percent in 1977, reflecting in large part local government contributions to the Electric Power Research Institute (EPRI). This organization was founded in 1973 by the Nation's public and private utility industries to develop and administer a coordinated national electric power R&D program. EPRI research concentrates on fossil fuel and advanced systems, nuclear power, electrical systems, and energy analysis and environment.

The city of Los Angeles was the leading local government in energy R&D involvement in 1977 (table 2). More than one-half of Los Angeles' energy R&D support represented funds contributed to EPRI, according to an industrywide formula based on kilowatt-hour sales. The same basis was used for other local government contributions to EPRI.

Local government support for environment R&D activities doubled between 1969 and 1977, placing work in this area at 18 percent of the overall R&D total. Most of the increase represented support provided by the Federal Environmental Protection Agency (EPA), which did not exist in 1969. An example of the effect of EPA support was a grant of $2.1 million for development of an area waste water management plan by the Nassau-Suffolk Regional Planning Board, which placed Suffolk County in New York State first in 1977 R&D expenditures in the environment area. This program encompassed cooperative water resource studies on stream flow, groundwater levels, chemical content and water quality. Suffolk County, along with four other local governments, namely, Chicago, Los Angeles City, Los Angeles County, and Seattle, accounted for one-half of the environment total in 1977.

Health is the only area of local government R&D expenditures that showed a decline between 1969 and 1977. The combined total from Federal, local, and other sources placed health R&D expenditures at 15 percent of the local government R&D total in 1977 (compared with 39 percent in 1969). While the federally supported portion of the health total remained approximately the same ($8 million in both 1969 and 1977), the amount provided directly from local government sources dropped from $7 million to $3 million. This situation is consistent with the present tendency of local and State governments to funnel their limited R&D dollars and resources into the

Table 2. Fifty local governments leading in expenditures for research and development by type and individual local government and functional area: FY 1977

(Thousands of dollars)

Type and individual government	Total	Health	Natural Resources	Education	Transportation	Income security and social services	Environment	Crime prevention and control	Economic growth and productivity	Area and community development, housing and public services	Science and technology base	Energy	Food, fiber, and other agricultural products
TOTAL	82 100	12 539	668	11 910	4 592	1 737	14 428	6 811	1 443	11 708	208	15 473	582
MUNICIPALITIES	44 669	6 621	161	1 792	2 804	994	6 087	4 274	1 116	9 202	165	11 453	-
LOS ANGELES, CALIF.	6 402	-	-	-	718	-	1 268	1 342	15	60	-	3 000	-
BOSTON, MASS.	3 499	3 277	-	-	-	-	-	-	221	-	-	-	-
CHICAGO, ILL.	3 220	-	-	1	818	100	1 803	127	-	333	-	38	-
NEW YORK, N.Y.	2 572	447	-	51	-	551	110	343	-	1 071	-	-	-
SAN FRANCISCO, CALIF.	2 022	306	-	-	359	-	560	41	365	391	-	-	-
PHILADELPHIA, PA.	1 933	1 441	-	-	-	-	443	-	-	-	-	-	-
NASHVILLE, TENN.	1 624	-	-	398	-	-	-	-	-	-	-	1 226	-
MEMPHIS, TENN.	1 438	-	-	-	-	-	-	-	-	-	-	1 438	-
WASHINGTON, D.C.	1 129	-	-	548	65	-	180	167	-	173	-	-	-
KANSAS CITY, MO.	1 020	-	-	-	-	-	-	852	-	164	4	-	-
DALLAS, TEX.	980	-	14	-	295	-	325	331	-	6	8	-	-
BALTIMORE, MD.	979	695	-	-	-	-	-	-	-	284	-	-	-
RIVERSIDE, CALIF.	955	-	-	-	-	-	-	79	113	155	2	606	-
CHATTANOOGA, TENN.	847	-	-	-	-	-	-	-	-	-	-	847	-
DETROIT, MICH.	841	-	-	-	-	-	-	115	-	726	-	-	-
SAN ANTONIO, TEX.	730	-	-	-	-	-	-	-	-	-	-	730	-
HONOLULU, HAWAII	722	-	27	-	71	-	185	369	60	-	-	10	-
KNOXVILLE, TENN.	635	-	-	-	-	-	-	-	-	-	-	635	-
SEATTLE, WASH.	631	-	-	-	-	-	-	-	-	508	8	115	-
RICHMOND, VA.	609	-	-	609	-	-	-	-	-	-	-	-	-
TUCSON, ARIZ.	514	-	-	-	91	-	396	-	-	26	-	-	-
HUNTSVILLE, ALA.	454	75	-	-	-	-	-	-	-	-	-	379	-
CINCINNATI, OHIO	387	95	-	-	150	-	138	-	-	-	4	-	-
ALL OTHER	10 526	284	120	189	237	343	629	508	342	5 305	139	2 429	-
COUNTIES	19 252	5 890	488	731	469	736	4 878	2 537	254	2 147	42	987	88
SUFFOLK COUNTY, N.Y.	2 523	-	488	-	-	-	2 083	-	-	-	-	-	-
NASSAU COUNTY, N.Y.	1 773	394	-	-	-	-	698	681	-	-	-	-	-
LOS ANGELES COUNTY, CALIF.	1 758	1 109	-	-	-	-	-	649	-	-	-	-	-
MONTGOMERY COUNTY, MD.	1 625	-	-	621	-	39	441	19	-	505	-	-	-
COOK COUNTY, ILL.	1 043	1 043	-	-	-	-	-	-	-	-	-	-	-
SANTA CLARA COUNTY, CALIF.	1 024	335	-	-	105	140	-	66	-	360	-	18	-
DADE COUNTY, FLA.	1 018	473	-	-	-	-	529	-	-	-	17	-	-
ORANGE COUNTY, CALIF.	741	348	-	-	-	-	-	161	100	132	-	-	-
RIVERSIDE COUNTY, CALIF.	631	-	-	-	-	15	124	491	-	-	-	-	-
SACRAMENTO COUNTY, CALIF.	590	590	-	-	-	-	-	-	-	-	-	-	-
SAN DIEGO COUNTY, CALIF.	578	-	-	-	-	-	-	-	58	-	-	524	-
SONOMA COUNTY, CALIF.	564	-	-	-	-	-	349	120	-	95	-	-	-
BEXAR COUNTY, TEX.	513	513	-	-	-	-	-	-	-	-	-	-	-
HENNEPIN COUNTY, MINN.	510	482	-	-	-	-	-	-	14	5	9	-	-
ADAMS COUNTY, COLO.	381	-	5	-	-	300	-	-	-	65	-	11	-
CONTRA COSTA COUNTY, CALIF.	365	-	-	-	-	110	65	50	5	85	-	50	-
ORANGE COUNTY, FLA.	357	-	-	-	-	-	357	-	-	-	-	-	-
ALL OTHER	3 258	603	43	116	364	132	232	300	81	900	16	384	88
SPECIAL DISTRICTS	8 500	-	15	-	1 319	-	3 308	-	67	279	-	3 034	478
SALT RIVER PROJECT, PHOENIX, ARIZ.	1 146	-	-	-	-	-	-	-	-	-	-	1 146	-
LOS ANGELES CO. SANITATION DISTRICT, WHITTIER, CALIF.	1 144	-	-	-	-	-	1 144	-	-	-	-	-	-
PORT AUTHORITY OF NEW YORK AND NEW JERSEY, NEW YORK, N.Y	1 072	-	-	-	847	-	-	-	-	225	-	-	-
MUNICIPALITY OF METROPOLITAN SEATTLE, WASH.	901	-	-	-	-	-	901	-	-	-	-	-	-
METROPOLITAN DENVER SEWAGE DISPOSAL DISTRICT 1, COLO.	735	-	-	-	-	-	600	-	-	-	-	-	135
WASHINGTON SUBURBAN SANITARY COMMISSION, HYATTSVILLE, MD.	667	-	-	-	-	-	357	-	-	-	-	-	310
SNOHOMISH COUNTY PUBLIC UTILITY DISTRICT 1, WASH.	474	-	-	-	-	-	-	-	-	-	-	474	-
METROPOLITAN WASTE CONTROL COMMISSION, ST. PAUL, MINN.	451	-	-	-	-	-	279	-	-	-	-	172	-
ALL OTHER	1 910	-	15	-	472	-	27	-	67	54	-	1 242	33
SCHOOL DISTRICTS	9 387	10	-	9 376	-	-	-	-	-	-	-	-	-
DETROIT CITY SCHOOL DISTRICT, MICH.	1 634	-	-	1 634	-	-	-	-	-	-	-	-	-
GRANITE SCHOOL DISTRICT, UTAH	351	-	-	351	-	-	-	-	-	-	-	-	-
MILWAUKEE CITY SCHOOL DISTRICT, WIS.	350	-	-	350	-	-	-	-	-	-	-	-	-
ALL OTHER	7 052	10	-	7 041	-	-	-	-	-	-	-	-	-
TOWNSHIPS	292	17	5	5	-	7	156	-	6	80	1	-	16

NOTE: Because of rounding, detail may not add to totals.

- Represents zero or less than $500.

SOURCE: National Science Foundation

solution of immediate, short-term problems and away from areas like health that call for longer-term research commitments. An exception to this situation was seen in the city of Boston, where the level of support for health rose from $2.5 million in 1969 to $3.3 million in 1977—making Boston the leading local government supporting this area both years. Again, the Federal Government (NIH) provided most of the R&D funding—more than 70 percent of the local governments' total in 1977.

Education also represented 15 percent of the total local government R&D effort in 1977. Three-fourths of this effort represented programs of in-

dependent school districts,and the rest, programs of public school systems that are subagencies of municipal and county governments. The Detroit School District led local government support of education R&D activities in 1977. It reported compensatory education research programs covering disadvantaged youths and adults, and the development and evaluation of materials and method for improved instruction.

Support for area and community development, housing and public services amounted to 14 percent of the local government R&D total in 1977. Support to this function was more widely dispersed among local governments than in the case of any other function. Many kinds of efforts were involved. New York City reported the largest R&D funding in 1977, with major emphasis placed on a computer-aided dispatching system and a computerized alarm assignment system for the New York City Fire Department.

Leading Local Governments

The local governments included in the survey were of five types: municipalities, counties, townships, school districts, and other special districts. Municipalities and counties dominated local government R&D activities in 1977, accounting for approximately four-fifths of the local government total, as was the case in 1966 and 1969 (chart 8). R&D activity at the local level tends to be concentrated in a relatively few large governments in terms of population. Thus, in 1977, the largest 50 of the 277 local governments reporting R&D expenditures accounted for almost 75 percent of the overall total. R&D activity, however, was more dispersed than in 1966 and 1969, when the 50 largest governments accounted for approximately 90 percent of the total.[8]

Of the 10 leading local governments in 1977, 6 were municipalities (Los Angeles, Boston, Chicago, New York, San Francisco, and Philadelphia); 3 were counties (Suffolk County, N.Y.; Nassau County, N.Y.; and Los Angeles County, Calif.); and 1 was a school district (Detroit City School District, Mich.) (table 2). These 10 local governments reported one-third of all local government R&D expenditures.

Many factors influence the level of R&D spending by individual local governments. Among the most important is the intergovernmental system within a State—whether its organization is highly centralized or decentralized. A recent study has shown that "Large population states tend to have more complex systems of local government while for small states the local system is simpler with more discrete jurisdictions."[9] Whereas the population, wealth of an area, and attitude and experience of public officials and local residents are all important factors in the degree and kind of R&D support, the fact remains that no R&D activities can be undertaken unless local jurisdictions can obtain (through Federal or State funding or their own taxing authority) funds to support R&D programs, nor can they conduct research in areas outside their proper domains. Future R&D expenditure levels may be adversely affected by trends observed at other government levels where taxing authority has been restricted and greater accountability of elected officials demanded in recent years.

Sources of Funds

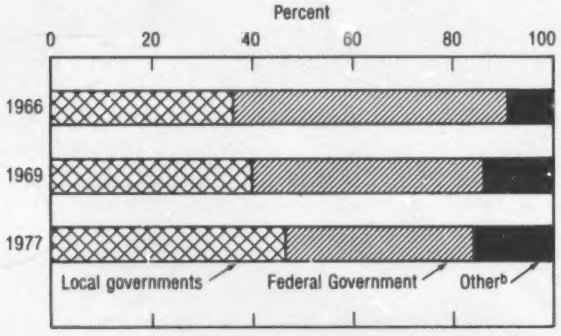
In 1977 local governments served as the major source of local R&D expenditures, accounting for 46 percent of the total. The Federal Government accounted for 38 percent and State governments for 15 percent. This represented a change from the sixties when the Federal Government was the leading source of funds (chart 10). Contributing to the higher level of local support in 1977 was the fact that 80 percent of energy R&D expenditures was funded directly through local government sources. Since energy has risen from virtually no expenditures to a position as the leading functional area, the amount of funding to energy has had a decided effect on overall R&D growth.

Twenty-six Federal agencies provided funds for local government R&D programs in 1977. Of these, five accounted for two-thirds of the Federal total; they were the Environmental Protection Agency, the National Institutes of Health

[8]Some of this change may result from the fact that the 1977 survey coverage was expanded to cover more governmental units. See technical notes in National Science Foundation, *Research and Development in State and Local Governments, Fiscal Year 1977* (Detailed Statistical Tables) (NSF 79-327) (Washington, D.C., 1980).

[9]G. Ross Stephens and Gerald W. Olsen. *Pass-Through Federal Aid and Interlevel Finance in the American Federal System, 1957-1977*, Vol. 1. A Report to the National Science Foundation (Springfield, Va: Department of Commerce, National Technical Information Service, PB2999-09, 1979.)

Chart 10. Distribution of local government R&D expenditures[a] by source of funds: selected years



[a]R&D plant excluded.
[b]Mainly State governments.
SOURCE: National Science Foundation

(HEW), the Law Enforcement Assistance Administration (Justice), the Department of Housing and Urban Development, and the Office of Education (HEW). As for State government support, the major portion was directed to school districts for education R&D programs and to municipalities and counties for area and community development R&D programs.

Performers

Most R&D expenditures of local governments represent direct performance by local government personnel. The share of the total, however, dropped from 80 percent in 1966 and 71 percent in 1969 to 61 percent in 1977 (chart 11). Over the years private firms and nonprofit organizations have increasingly been used in the performance of local government R&D programs. Many projects are short-term in nature, and according to local government officials, the use of extramural capabilities for these projects is more cost effective than placing additional scientific and technical personnel on permanent local government payrolls.

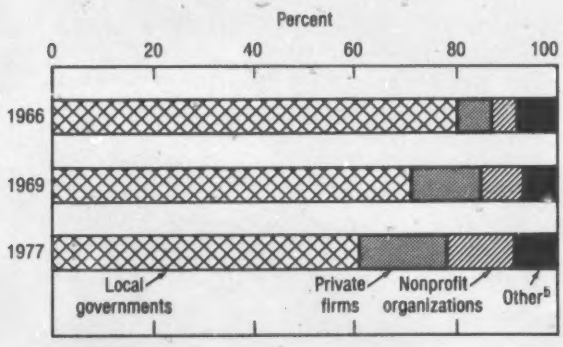
Nonprofit organizations accounted for an increasing share of the total between 1969 and 1977, a rise from 8 percent to 13 percent. Again the effects of energy efforts were apparent. Virtually all of the increase resulted from performance by EPRI in energy areas. Private firms also accounted for an increasing share of total local government R&D performance. Their share of the total rose from 14 percent in 1969 to 17 percent in 1977. The increase was seen primarily in work in the environment and the area and community development, housing, and public services functions.

Universities and colleges and Federal and State government agencies, which performed the remainder of local government R&D undertakings, also accounted for an increasing share of the R&D total—from 7 percent in 1969 to 10 percent in 1977.

Character of Work

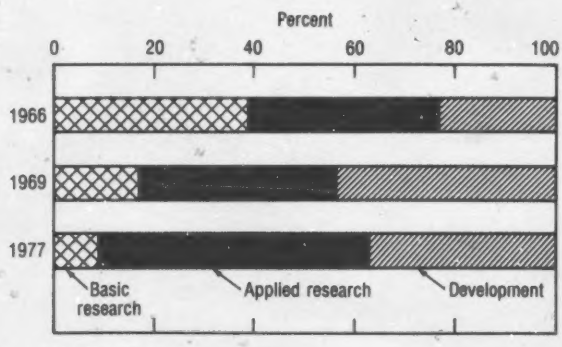
In 1977 applied research accounted for 54 percent of the local government R&D total; development, for 37 percent; and basic research, for 9 percent. These figures reflect a shift away from support of basic research, and, to a lesser extent, development (chart 12). The drop in the

Chart 11. Distribution of local government R&D expenditures[a] by performer: selected years



[a]R&D plant excluded.
[b]Includes universities and colleges, and Federal and State agencies.
SOURCE: National Science Foundation

Chart 12. Distribution of local government R&D expenditures by character of work: selected years



SOURCE: National Science Foundation

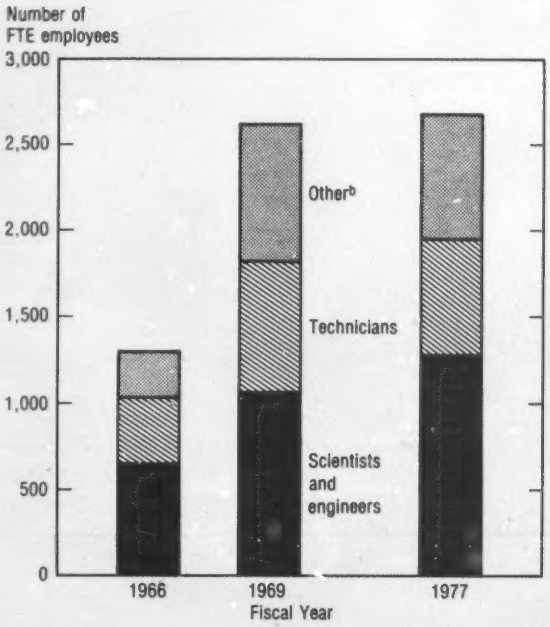
basic research share resulted mainly from a drop in basic research support for health R&D activities. Since basic research in the health area accounted for more than 90 percent of total local government basic research support in 1966 and 1969 and more than 70 percent in 1977, the impact of this decrease on the overall basic total is readily apparent. The decline in health basic research was part of a relative decline in health research and development from 55 percent of total local government R&D expenditures in 1966, to 39 percent in 1969 and 15 percent in 1977. The increased emphasis on applied research reflected the problem-oriented objectives of most local government activity, as revealed by the survey responses, and the use of R&D findings to meet recognized needs of a fairly immediate nature. Development activities were chiefly found in education, as was the case with State-sponsored R&D programs.

R&D Personnel

The use of FTE personnel for intramural performance of the R&D activities of local governments increased 2 percent from 1969 to 1977 (chart 13). In 1977 approximately 1,300 scientists, 650 technicians, and 730 support personnel were involved in such work. The average cost per scientist/engineer was approximately $39,000 in 1977, compared with $27,000 in 1969 and $25,000 in 1966. These increases do not allow for the effects of inflation, especially between 1969 and 1977 when the drop amounted to 13 percent in real terms.

In 1977 two-thirds of local R&D personnel were working in three areas: education; health; and area and community development, housing and public services. In education, R&D personnel were chiefly employed by school districts; in health they were chiefly employed by municipalities and counties; in area and community development, housing and public services, they were primarily employed by municipalities.

Chart 13. Distribution of FTE[a] personnel engaged in local government intramural R&D activities by type: selected years



[a]Full-time-equivalent.
[b]Clerical and administrative support personnel.
SOURCE: National Science Foundation

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Further information is available in *Research and Development in State and Local Governments, Fiscal Year 1977* (Detailed Statistical Tables) (NSF 79-327) from the National Science Foundation, Washington, D.C. 20550.

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